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This adult *(Litoria alboguttata)* is the male of the breeding pair that features in an article in this issue. The front-on view shows its whitish undersurface and the curved snout. H. Ehmann

This adult male Pygmy Copperhead *(Austrelaps labialis)* is poised to strike but reluctant to bite. It is photographed in its habitat in the Mt Lofty - Mt Bonython summits area. The vegetation is a dry sclerophyll woodland with a diverse heath and (in places) tussock grass understorey. An article on this species appears in this issue. H. Ehmann.

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THE DISTRIBUTION AND ECOLOGY OF THE PYGMY COPPERHEAD SNAKE *(AUSTRELAPS LABIALIS)*

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ABSTRACT

Distributional, dietary and growth rate data on *Austrelaps labialis* are presented. The future of this species in the Mt Lofty Ranges appears to be jeopardised by the encroachment of other elapid snakes and cats into its range.

INTRODUCTION

The Pygmy Copperhead *(Austrelaps labialis)* is a medium sized ovoviviparous elapid snake which has traditionally been grouped with the Lowland Copperhead *(A. superbus)*. However, recent morphometric and electrophoretic studies (Rawlinson 1969, Lombardi 1985, Schwaner 1985) clearly indicate that *A. labialis* is distinct from both *A. superbus* and the Highland Copperhead *(A. ramsayi)*. Pygmy Copperheads are endemic to Kangaroo Island and the Mt Lofty Ranges of South Australia. They are considered to be rare (Mirtschin and Davis 1982) and furthermore their restricted range necessitates that they require protective legislation (Bredl et al. 1988).

Adult Pygmy Copperheads feed predominantly on small skinks; although frogs, lizard eggs, mice and invertebrates are occasionally eaten (Shine 1987). Little is known of the detailed ecology of this unobtrusive species. The ecology of congeneric copperheads in the eastern states has been extensively studied (Shine and Bull 1977, Shine 1978, Shine 1987, etc.). However, because the Pygmy Copperhead is a distinct species, occupying different habitats and geographic regions to the other copperheads, only very general comparisons between these species are possible.

This study investigated the distribution and ecology of the Pygmy Copperhead in order to determine the current status of this species.

METHODS

Distributional data on the Pygmy Copperhead were collected by obtaining records from the South Australian Museum, the Australian Museum and amateur herpetologists. Recorded sites were entered into the Geographic Information Systems data base of the South Australian Department of Environment and Planning which allowed habitat information such as vegetation type, altitude and rainfall for each site to be derived. An accurate distributional map for the species was produced.

Localities where Pygmy Copperheads had been recorded were visited and searches for snakes and potential prey were conducted. In addition searches were made in many natural scrub regions in the Mt Lofty Ranges and Fleurieu Peninsula where copperheads had not been recorded. National Parks rangers and landholders were also approached to determine whether copperheads had been sighted in these extra-limital regions. Field work was conducted from January 1988 to March 1989.

Four Pygmy Copperheads were captured from the wild, housed in indoor aquaria, and offered a range of food items in order to determine dietary range and preference. During the course of the study a female gave birth to eight young. These juvenile snakes were individually marked by clipping ventral scales. Snout-vent, tail and weight measurements were recorded weekly for the first three months and then fortnightly for a further fourteen months.

All of the adult snakes and the surviving juvenile snakes were returned to their point of capture at the conclusion of the study.

RESULTS

The distribution of Pygmy Copperheads is presented in Figure 1. There are 57 records from the Mt Lofty Ranges and 72 from Kangaroo Island. Pygmy copperheads are widespread on Kangaroo Island but mostly confined to a restricted range of approximately 150km^2 in the Adelaide Hills (Fig.1)

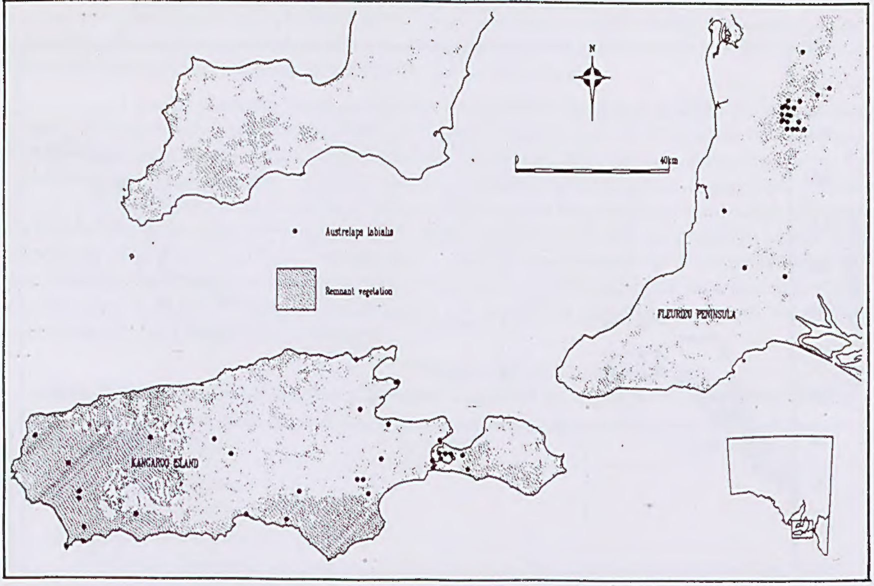
Pygmy Copperheads have been recorded from a broad range of habitats on Kangaroo Island including coastal dunes, samphire flats, open grassland, heath, closed sclerophyll woodland and agricultural areas. In complete contrast the Mt Lofty Ranges Copperheads are largely restricted to a very defined habitat type, high altitude stringybark forest. Thirty-nine of the forty-one localities for which vegetation information could be derived in the Mt Lofty Ranges were in stringybark (*Eucalyptus obliqua* and *E. baxteri)* forest with understories of *Lomandra* spp., *Hakea rostrata*, heath or introduced species. The remaining two sites were in Blue Gum *(E. leucoxylon)* and Pink Gum *(E. fasciculosa)* woodland. Ninety per cent of these sites receive an average annual rainfall between 800 and 1000mm. Most localities that could be accurately determined were near the tops of hills and were characterised by a near closed canopy and dense heath or bracken understorey. Resting copperheads were usually found under rocks or iron.

Grasslands, lowland sclerophyll forests, coastal heaths and dune systems which are occupied by Kangaroo Island populations of Pygmy Copperheads are apparently not inhabited by the same species on the mainland. Multiple searches of many National, Conservation and Recreation Parks including Deep Creek, Newland Head, Scott, Horsnell Gully, Belair and low reaches of Cleland along with isolated patches of native scrub throughout the Fleurieu Peninsula failed to locate any copperheads.

Two Pygmy Copperheads from both Kangaroo Island and the Mount Lofty Ranges were captured. The range of food types offered to and consumed by these captive copperheads is presented in Table 2. Small skinks mainly *Lampropholis guichenoti, Lerista bougainvillii, Hemiergis decresiensis* and *H. peronii* were the preferred prey of both adult and juvenile copperheads but the adults readily consumed larger skinks such as *Ctenotus robustus, Egernia whitii* and *Eulamprus quoyii.* Although geckoes, gecko eggs and insects are recorded in the diets of wild animals (Shine 1987) these were ignored by the captive snakes with the exception of a single Tree Dtella *(Gehyra variegata)* which was eaten by a hungry adult. No evidence of cannibalism was recorded although the young snakes were removed from the adults at an early age and were always provided with adequate skinks.

The small Three-toed Skink *(Hemiergis decresienis)* and the larger White's Skink *(Egernia whitii)* were frequently recorded throughout Kangaroo Island and probably dominate the diet of the Pygmy Copperhead there. Other potential prey species recorded from Kangaroo Island are Grass Skinks *(Lampropholis guichenoti)* and other small skinks which inhabit leaf litter including *Hemiergis peronii. Lampropholis guichenoti, Hemiergis decresiensis, Lerista bougainvillii* and *Menetia greyii* were the most commonly encountered potential food species recorded within the Pygmy Copperhead's Mt Lofty Range. Froglets, *Leiolopisma spp., Eulamprus quoyii* and *Egernia whitii* were also present at several localities and probably contributed significantly to the diet of the copperheads.

Figure 1. Distribution of *Austrelaps labialis*



The sizes of the snakes captured during this study are presented in Table 1. The male snake captured from Arbury Park was a particularly large specimen measuring a total of 875mm, which is 125mm longer than the largest *A. labialis* previously recorded (Shine 1987). Eight juvenile snakes were born live during the early morning (approximately 1:00am) of 28 February 1989, which conforms with the average clutch size for this species of 7.4 (Shine 1987). These snakes weighed an average of 3.2gms at birth and the post-birth weight of the female snake was 48.8gms. Therefore, the relative clutch mass of this individual was approximately 50%.

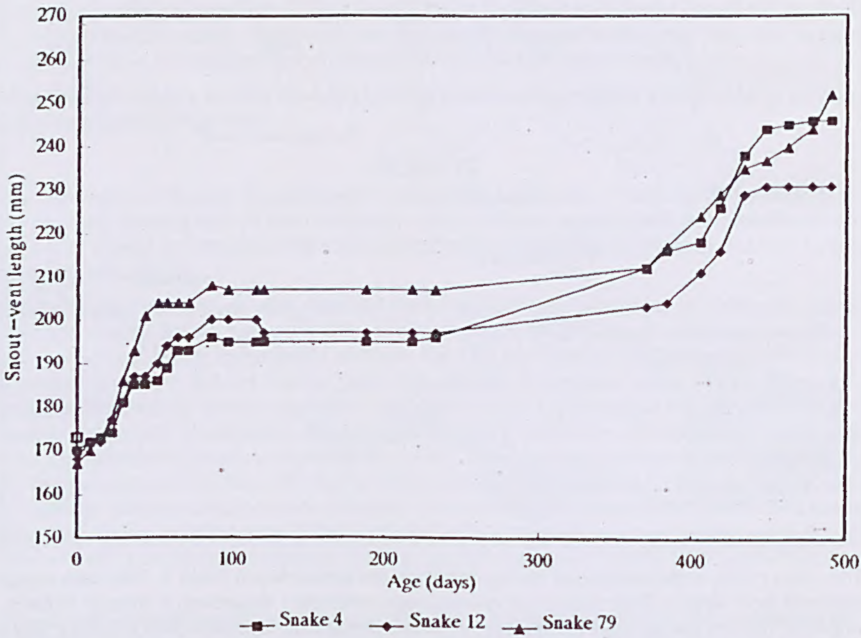
Growth rates of all of the juveniles were high and essentially linear for the first four months (mean 2.8mm per week;n=8) but slowed dramatically in the period from April 5, 1989 until January 8, 1990 (mean 0.1mm per week;n=5). Unfortunately five juveniles succumbed to a parasite infection from October 1989 to January 1990 so data are only available for three snakes for the second growing season. From 13 February, 1990 until 16 May, 1990 the growth rate of these individuals once again approached a linear 2.5mm per week (n=3). Figure 2 shows the snout-vent measurements of the three surviving snakes until they were released in June 1990. The growth rates of the other individuals throughout their life-span was not significantly different from the three surviving individuals.

Two Pygmy Copperhead Snakes were recorded as prey of domestic cats in the Adelaide Hills. The cat predation rate on copperheads may be significant as the domestic and feral cat population in the Mt Lofty Ranges appears to be quite large (pers obs.).

Table 1. Measurements of *A. labialis* Specimens used in this Study

SPECIMEN	SVL	TAIL	WEIGHT
KI female	490	90	50.6
AP female	533	93	61.0
AP male	745	130	185.5

Figure 2. Growth Rates of Juvenile *Austrelaps labialis* in Captivity



DISCUSSION

Pygmy Copperheads occupy a much narrower habitat range on the mainland compared to Kangaroo Island which suggests that factors other than habitat suitability may limit their distribution on the mainland. Availability of sufficient prey items is not implicated in the range limitation because many potential prey species occur in habitats adjacent to the current range of the Pygmy Copperhead. Although early records are sparse, there is no indication that Pygmy Copperheads occupied a broader range of habitats on the mainland before the effects of white civilisation and exotic flora and fauna became significant. In addition, the coexistence of copperheads with low density urbanisation on Kangaroo Island implies that these snakes are able to adapt to some degree of habitat change. This evidence implies that a natural range limiting phenomenon operates on the mainland population which does not effect the Kangaroo Island population. One such factor could be competition or predation by other elapid snakes.

Tiger Snakes *(Notechis scutatus)* coexist with Pygmy Copperheads in many parts of Kangaroo Island, although these two species are rarely sighted together (P. Reismiller pers. comm., pers. obs.). Pygmy Copperheads may therefore avoid competition with Tiger Snakes by becoming active at different times.

Tiger snakes are not common in the Mt Lofty Ranges, however Common Brown Snakes *(Pseudonaja textilis)* and Red-bellied Black Snakes *(Pseudechis porphyriacus)* are common in parts of the ranges. Brown Snakes tend to occupy savannah grasslands (pers. obs.) and avoid wet schlerophyll forests (Wilson and Knowles 1988) while Red-bellied Black Snakes generally concentrate around swamps and creeks (Shine 1978b). Although both of these species were found in regions adjacent to those sites where copperheads were recorded (Yeatmann and Alexander 1978, B. Foreman pers. comm., pers. obs.), brown and black snakes

were only found at one locality where Copperheads had been recorded. Cox's Scrub Conservation Park supported a population of both brown and black snakes during the survey period. Copperheads were also recorded at this locality prior to an intense bushfire in 1983 which may have also altered the suitability of the habitat for snake species.

On mainland South Australia Common Brown and Red-bellied Black Snakes occupy several of the vegetation associations inhabited by Pygmy Copperheads on Kangaroo Island. These large snakes would potentially compete for food resources with, or even prey directly on, the smaller Pygmy Copperheads. If this is the case copperheads would be forced into habitats unfavourable to brown or black snakes. This scenario would explain the current range of Pygmy Copperheads in the Mt Lofty Ranges. A predation exclusion theory such as this can only be accurately tested with exclosure experiments, fencing copperheads in different habitats with and without other elapids and comparing survival rates. Unfortunately the logistics, and ethics, of obtaining sufficient Pygmy Copperheads to conduct a statistically sound experiment precluded us from testing this hypothesis.

Table 2. Food Types offered to Adult and Juvenile *A. labialis* in Laboratory Trials

FOOD TYPES	ADULTS	JUVENILES
Ctenotus robustus	+	-
Egernia whitii	+	-
Hemiergis decresiensis	+	+
Hemiergis peronii	+	+
Lamprophoilis guichenoti	+	+
Lerista bougainvillii	+	+
Menetia greyii	+	+
Morethia boulengeri	+	+
Eulamprus quoyii	+	n.o.
Gehyra variegata	+	-
Toadlets (*Ranidella* sp.)	+	-
Mus domesticus	+	n.o.
Crickets	-	-
Slaters	-	-

+ = prey item eaten; - = prey item not eaten; n.o. = not offered

This study has shown that Pygmy Copperhead Snakes are confined to a narrow geographical and ecological zone in the Mt Lofty Ranges. Clearance of sclerophyll scrub in this zone for agriculture or housing appears to result in the displacement of copperheads. One possible explanation for this phenomenon is that these habitat modifications enable brown or black snakes to encroach into the habitat of the Pygmy Copperhead and drive out the smaller species by competition or predation.

The growth rate study of the juvenile snakes revealed that these Pygmy Copperheads grew slowly under experimental conditions. Growth rates were essentially linear but punctuated by a period of minimal growth during winter and spring. This is contrary to the rapid parabolic growth rate reported for Death Adders *(Acanthophis antarcticus)* in their first twelve months (Mirtschin and Davis 1982). The Pygmy Copperheads increased their birth length by an average of 24.2% in their first year which is considerably slower than the growth rate of Tiger Snakes, Red-bellied Black Snakes and Eastern Copperheads of over 100% (Shine 1978). Together with the low reproductive output of this species these slow growth rates render the Pygmy Copperhead a poor competitor with other elapids when forced into competition.

Feral and free-ranging domestic cats may reduce Pygmy Copperhead populations. This predation will intensify as more houses, and hence cats, are introduced into the copperhead's range which is experiencing one of the fastest human population growth rates in South Australia (Forster and Stimson 1977).

These factors suggest that the Mt Lofty population of Pygmy Copperheads is threatened with extinction if current landuse practises and lack of responsibility with family pets continues. Every effort should be made to conserve as much of the dense *E. obliqua* community as possible in the Mt Lofty Ranges. The control of both domestic and feral cats throughout the range of the Pygmy Copperhead may also be imperative for the survival of this species.

ACKNOWLEDGMENTS

Louise Mitchell from the information Systems Branch of the South Australian Department of Environment and Planning produced Figure 1. and assisted with the habitat analysis. Ralph Foster maintained and measured the juvenile snakes from mid May 1989 until their release. The South Australian National Parks and Wildlife Service issued permits to take copperheads and food lizards from the wild. Dr Keith Christian and Dr Thomas Madsen kindly commented on earlier drafts of this paper.

REFERENCES

Bredl, J., T. Mirtschin, P. and Coombe, G., 198?. *Recommendations to the dangerous snakes conference.* Adelaide.

Forster, C.A. and Stimson, R.J. 1977. *Urban South Australia - Selected Readings.* Centre for Applied Social and Survey Research.

Gow, G.F. (1976) *Snakes of Australia.* Angus and Robertson. Sydney.

Lombardi, M. (1985). *Variation and Systematics of the Elapid Snake Genus Austrelaps (Worrell) in South Australia.* Unpubl. BSc Honours Thesis. University of Adelaide.

Mirtschin, P. and Davis, R. (1982). *Dangerous snakes of Australia.* Rigby. Adelaide.

Schwaner, T.D. (1985). *Snakes in South Australia. A species list and overview.* S.A. Museum: Adelaide.

Shine, R. (1987) Ecological ramifications of prey size: food habits and reproductive biology of Australian Copperhead snakes (*Austrelaps*, Elapidae). *J. Herpetol.* 21:1 21-28.

Shine, R. (1978) Growth rates and sexual maturation in six species of Australian elapid snakes. *Herpetologica* 34: 73-79.

Shine, R. and Bull, J.J. (1977). Skewed sex ratios in snakes. *Copeia* 1977: 2 228:234.

Yeatmann, E. and Alexander, P. (1979). *Cleland Conservation park fauna survey. Report 3.* N.P.W.S. Internal report.

NESTING OF THE SOUTHERN RAINFOREST DRAGON, *HYPSILURUS SPINIPES* (SQUAMATA: AGAMINAE)

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INTRODUCTION

The two Australian species of rainforest dragon *(Hypsilurus)* are among the most distinctive members of the Australian agamid fauna. Both are extremely cryptic in both coloration and habits and are difficult to locate in the field. Consequently, they remain poorly known. With the exception of morphological data, the primary literature on the southern rainforest dragon, *Hypsilurus spinipes,* is scanty, largely limited to some observations on captive specimens (Longley, 1943), notes on crypsis (Bustard, 1970; Bevan, 1983) and a record of apparent male combat (Worrell, 1963).

Despite this lack of data, *Hypsilurus spinipes* is currently placed on Schedule 12, Part 3 (Threatened Fauna) of the New South Wales National Parks and Wildlife Act, being fauna occurring "in restricted habitat, in numbers adequate for survival and possibly common over parts of its range, but which has declined in numbers at a rate which gives cause for concern" (Ehmann and Cogger, 1985).

In this paper, we report field observations on nesting in this species. Our use of the generic name *Hypsilurus* for the Australopapuan *"Gonocephalus"* follows the conclusion of Moody (1980), adopted by Böhme (1988) and Wilson and Knowles (1988), while reduction of the family Agamidae to a subfamily within the family Chamaeleonidae follows Frost and Etheridge (1989).

OBSERVATIONS

On the afternoon of 6 December, 1987, an overcast, humid, hot day, one of us (J.W.) observed eight heavily gravid female *H. spinipes* on forest roads through rainforest in Barrington Tops National Park NSW. Seven of these were found in one small clearing in the rainforest. On the afternoons of 3-4 December, 1989, between 1300-1600hrs, two of us (G.S, G.H.) observed a total of 17 *H. spinipes* on or alongside tracks and forestry roads. One was in Barrington Tops National Park, near Barrington Guest House, the others in Chichester State Forest, NSW. In all but one case, the surrounding habitat was rainforest or wet sclerophyll forest. The exception was a subadult female basking in late afternoon in the middle of a road passing along an ecotone between wet sclerophyll forest and dry sclerophyll woodland on a steep hill slope. All other specimens were apparently gravid females (determined either by palpation of shelled eggs through the abdominal wall or observation of greatly distended abdomens bulging with eggs), all but one closely associated (within 10cm) with freshly scraped depressions in the soil. The scrapings were triangular in outline, approximately 6cm along each side, reaching a maximum depth of about 4cm at the apex. Often several freshly scraped depressions were present in close proximity, and many more were noted in similar situations apparently without dragons in attendance. Most scrapings were in open areas, particularly areas with sparse low clumps of grass and a thin layer of leaf litter and small pebbles, both on the edge of tracks and in the vegetated strip between ruts, although a few scratchings (mostly unattended) were found on bare ground in the wheel ruts. The soil in all cases was red clay loam, relatively hard packed. Few scrapings were observed in loose soil that had subsided from cuttings at several points.

Almost all dragons were facing towards the depression, from the side opposite the deep apex. Most individuals were lying flat to the ground when first observed, and were very difficult to discern in the surrounding leaf litter (Fig. 1) Indeed, our attention was first drawn to several by the fresh scrapings, and in two cases, the animal was not seen until it moved when we began to move leaf litter around the scraping.

Figure 1. Gravid female *Hypsilurus spinipes* with partially excavated nest.

Towards the end of the observation period on 3 December, an approaching storm resulted in rapid change in weather conditions from sunshine to very heavily overcast conditions with poor visibility, and a strong cool gusty wind, followed by torrential rain. The last female observed was still closely associated with a scraping as the rain began to fall, despite the lack of sunshine for the previous 30 minutes.

One female was found on 4 December with head and forelimbs caked with soil, facing away from a clutch of eight eggs in the apex of a scraping, with a small amount of soil partially covering some eggs (Fig. 2). We believe that this female was beginning top fill in a completed nest.

A second clutch of seven eggs (one broken and freshly cleaned out by ants) was found on the same day, partially exposed, in a partially filled scraping without attendant dragon, and a third clutch of five partially dehydrated eggs fully exposed in an excavation in hard dry loam, prior to the storm on 3 December. Three eggs from the clutch of seven had lengths and widths of 22.5 x 13.0mm, 23.3 x 13.3mm and 23.7 x 11.4mm, and mass 1.96 - 2.32g (x = 2.17g).

Figure 2. Female *Hypsilurus spinipes* and clutch in partly filled nest.

DISCUSSION

The observation of numbers of gravid females on almost the same date in different years, in hot, humid conditions associated with rain or cloud suggests that egg laying in *H. spinipes* is at peak at the beginning of summer, possibly triggered by rain. This is consistent with observations of hatchlings appearing in late summer (Wilson and Knowles, 1988) and an incubation period of 6-8 weeks for the congener *H. godeffroyi* (McCoy, 1978, 1980).

The clutch sizes recorded here are slightly greater than the only previously published record (3-6: Wilson and Knowles, 1988), and much larger than for two congeners (3: *H. boydii*, Wells, 1972; 2-3: *H. godeffroyii*, McCoy, 1978, 1980), despite the smaller size of this species (maximum SVL 110mm vs 150mm for *H. boydii* and 113mm for female *H. godeffroyii*; Cogger, 1986; Hediger, 1934). These observations are in agreement with general trends for clutch size of tropical reptiles to be smaller than for temperate species (Tinkle *et al.*, 1970), but are contrary to the findings of James and Shine (1988), based largely on Australian skinks, that such differences occur mainly between genera rather than within genera.

From the consistent form of the excavations observed, both with and without eggs, we believe that *H. spinipes* normally nests in shallow depressions, barely covering the eggs. This is unlike other Australian agamids for which specific field observations are available, all of which apparently dig nesting burrows (*Amphibolurus nobbi coggeri*, Sadlier and Shea, 1990; *Ctenophorus fordi*, Cogger, 1978; *C. maculosus*, Mitchell, 1973; *Diporiphora winneckei*, Houston, 1978; *Moloch*, Hudson, 1977; *Pogona minor*, Browne-Cooper, 1984; *P. vitticeps*, Johnston, 1979). Other authors have reported "digging up" agamid eggs, implying some sort of nesting burrow (*Chelosania*, Pengilley, 1982; *Chlamydosaurus*, Harcourt, 1986). Although some of these species and others have been recorded depositing eggs on the surface under captive conditions (e.g., *Amphibolurus muricatus*, Groom, 1973; *Chlamydosaurus*, Harcourt, 1986; *Pogona nullarbor*, Smith and Schwaner, 1981; *P. vitticeps*, Johnston, 1979), this has been ascribed to inadequate provision of nesting sites (Johnston, 1979). The shallow nesting we observed cannot be ascribed to unsuitable sites. Nearby loose soil with similar exposure to the nest sites was barely utilised. While the hard soil was dry and obviously difficult to dig in on 3 December, it was much softer the following day after rain, yet females were still laying in shallow depressions. Shallow nesting has also been reported for *H. godeffroyi*: McCoy (1980) records eggs "laid in rotting timber or in moist humus on the ground". Wilson and Knowles (1988) record nesting "in a burrow, usually in a rainforest clearing" for *H. spinipes*, but provide no other details. Further field observations are needed to confirm this statement.

Finally, our observations of large numbers of gravid females nesting simultaneously provide some evidence that *H. spinipes* may not be as rare as their protected status would suggest. Despite several previous trips to the same area at different times of the year specifically searching for *H. spinipes* for photography (G.S., G.H.), they were only seen on the December trip, and even then were often difficult to see.

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REFERENCES

Bevan, J. (1983). A defensive reaction of *Gonocephalus spinipes* (Dumeril). *Herpetofauna* 14(1-2): 99.

Böhme, W. (1988). Zur Genitalmorphologie der Sauria: funktionelle und stammesgeschichtliche aspekte. *Bonner Zoologische Monographien* (27): 1-116.

Browne-Cooper, R. (1984). Notes on the reproduction of the bearded dragon *Pogona minor*. *Herpetofauna* 15(1-2): 49.

Bustard, H.R. (1970). *Australian Lizards*. William Collins, Sydney. (162pp.)

Cogger, H.G. (1978). Reproductive cycles, fat body cycles and socio-sexual behaviour in the mallee dragon, *Amphibolurus fordi* (Lacertilia: Agamidae). *Australian Journal of Zoology* 26: 653-672.

Cogger, H.G. (1986). *Reptiles and amphibians of Australia.* 4th edn. Reed Books, Frenchs Forest. (688pp.)

Ehmann, H. and Cogger, H. (1985). Australia's endangered herpetofauna: a review of criteria and policies. pp. 435-447. *In*, Grigg, G., Shine, R. and Ehmann, H. (eds.). *Biology of Australasian Frogs and Reptiles.* Surrey Beatty and Sons, with the Royal Zoological Society of New South Wales, Sydney. (527pp.)

Frost, D.R. and Etheridge, R. (1989). A Phylogenetic Analysis and Taxonomy of Iguanian Lizards (Reptilia: Squamata). *University of Kansas Museum of Natural History Miscellaneous Publications* (81): 1-65.

Groom, S. (1973). Notes on the keeping and distribution of the Jacky Lizard *(Amphibolurus muricatus). Herpetofauna* 5(4): 3-5.

Harcourt, N. (1986). A Review of the Frilled Lizard *(Chlamydosaurus kingii)* in Captivity. *Thylacinus* II(3): 16-18.

Hediger, H. (1934). Beitrag zur Herpetologie und Zoogeographie Neu Britanniens und einiger umliegender Gebiete. *Zoologische Jährbücher. Abteilung für Systematik, Okologie und Geographie der Tiere* 65(5/6): 441-585.

Houston, T.F. (1978). *Dragon Lizards and Goannas of South Australia.* South Australian Museum, Adelaide. (84pp.)

Hudson, P. (1977). An account of egg laying by the Thorny Devil, *Moloch horridus* (Gray). *Herpetofauna* 9(1): 23-24.

James, C. and Shine, R. (1988). Life-history strategies of Australian lizards: a comparison between the tropics and the temperate zone. *Oecologia* 75:307-316.

Johnston, G.R. (1979). The eggs, Incubation and Young of the Bearded Dragon *Amphibolurus vitticeps* Ahl. *Herpetofauna* 11(1): 5-8.

Longley, G. (1943) Notes on *Goniocephalus cristipes. Proceedings of the Royal Zoological Society of New South Wales* 1942-43: 30-31.

McCoy, M. (1978). The agamid *Gonocephalus godeffroyi* in the Solomon Islands. *Herpetofauna* 10(1): 2-4.

McCoy, M (1980). *Reptiles of the Solomon Islands.* Wau Ecology Institute Handbook (7), Wau. (80pp.)

Mitchell, F.J. (1973) Studies on the ecology of the agamid lizard *Amphibolurus maculosus* (Mitchell). *Transactions of the Royal Society of South Australia* 97: 47-76.

Moody, S.M. (1981). Phylogenetic and historical biogeographical relationships of the genera in the family Agamidae (Reptilia: Lacertilia). Ph.D. thesis, University of Michigan. (373pp.)

Pengilley, R. (1982). Note on the reproductive biology of the ring-tailed dragon *(Chelosania brunnea). Northern Territory Naturalist* (5): 6.

Sadlier, R.A. and Shea, G.M. (1990). The reptiles of Mungo National Park and the Willandra Lakes region. *Herpetofauna* 19(2): 9-27.

Smith, J. and Schwaner, T.D. (1981). Notes on reproduction by captive *Amphibolurus nullarbor* (Sauria: Agamidae). *Transactions of the Royal Society of South Australia* 105(4): 215-216.

Tinkle, D.W., Wilbur, H.M. and Tilley, S.G. (1970). Evolutionary strategies in lizard reproduction. *Evolution* 24(1): 55-74.

Wells, R. (1972). Notes on *Goniocephalus boydii* (Macleay). *Herpetofauna* 5(2): 24.

Wilson, S.K. and Knowles, D.G. (1988). *Australia's Reptiles A Photographic Reference to the Terrestrial Reptiles of Australia.* William Collins, Sydney. (447pp.)

Worrell, E. (1963). *Reptiles of Australia.* Angus and Robertson, Sydney (207pp.)

CALLING BEHAVIOUR IN THE MICROHYLID *COPHIXALUS ORNATUS*

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The Australian frog family about whose reproductive biology and general ecology we know the least is the Microhylidae. Most microhylids live in rainforest at high elevations in tropical north Queensland (Tyler, 1976), making them difficult to study. One species that is found in more accessible areas is *Cophixalus ornatus*. It is widely accepted that males of this species call from low vegetation in rainforests (Cogger, 1986; Frith and Frith, 1987). Zweifel (1985) describes several instances of frogs found exhibiting this behaviour and also mentions finding several frogs calling from positions on the trunks of trees. Recently I found several male *C. ornatus* calling from tree-trunks in rainforest in Palmerston National Park near Cairns. The frogs were spreadeagled in crevices in trees so that all four legs were touching the edges of the depression (Fig.1). Also observed less than a metre from these frogs was a Brown Tree Snake *(Boiga irregularis)* actively foraging amongst the low level vegetation.

A frog that is calling from a crevice in a tree is likely to be less vulnerable to predation than a frog that is calling from the vegetation, particularly if the predator is a tree snake. Resources such as depressions in trees may be expected to be fairly limited and hence frogs may compete for these positions. It has been suggested that the calls of male microhylids may serve a territorial function as well as a reproductive one, and an apparent territorial confrontation has been observed in this species (Zweifel, 1969, 1975). Studies on other frog species have shown that when males exhibit territoriality the resources being defended are typically either calling sites (Greer and Wells, 1980; Robertson, 1986) or nesting sites (Howard, 1978). Female frogs often choose their mates using criteria relating to the quality of a male's territory (Howard, 1978). Thus males that hold superior territories enjoy greater reproductive success.

Several questions related to the ecology and social behaviour of *C. ornatus* arise from the above observations. The first question that requires answering is whether or not males calling from vegetation suffer increased predation over males that call from tree crevices. Whether or not this is the case several other questions relating to the mating behaviour of the species also arise. For example, do males calling from these positions gain differential mating success? The ability to obtain a superior calling site (such as one that gives greater protection from predation) may be used by females as an indicator of the fitness of potential mates. Females may also recognise that males calling from these positions are less open to predation and hence their offspring may share this characteristic. This may then prompt us to ask whether or not males are more likely to attempt to steal the territory of a male calling from a tree depression than a male calling from another position. If so, what form do territorial confrontations take, when do they occur and what factors determine the outcome? Clearly much work is required to enhance our understanding of the basic biology of this and other species of microhylid frogs.

ACKNOWLEDGMENTS

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REFERENCES

Cogger, H.G. 1986. *Reptiles and Amphibians of Australia.* Reed, Sydney.

Frith, C. and D. Frith. 1987. *Australian Tropical Reptiles and Frogs.* Tropical Australia Graphics, Townsville.

Greer, B.J. and K.D. Wells. 1980. Territorial and reproductive behaviour of the tropical American frog *Centrolenella fleischmanni*. *Herpetologica*. 36: 318-326.

Howard, R.D. 1978. The evolution of mating strategies in bullfrogs, *Rana catasbeiana*. *Evolution*. 32: 850-871.

Robertson, J.G.M. 1986. Male territoriality, fighting and assessment of fighting ability in the Australian frog *Uperoleia rugosa*. *Anim. Behav.* 34: 763-772.

Tyler, M. 1982. *Frogs.* 2nd Ed. Collins, Sydney.

Zweifel, R.G. 1969. Frogs of the genus *Platymantis* (Ranidae) in New Guinea with the description of a new species. *Am. Mus. Novit.* No. 2374: 1-20.

Zweifel, R.G. 1975. Australasian frogs of the family Microhylidae. *Bull. Am. Mus. Nat. Hist.* 182: 265-388.

Figure 1. A male *Cophixalus ornatus* calling from a depression in a tree.

RAINWATER DRINKING BY THE SEA KRAIT *LATICAUDA COLUBRINA*

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Sea kraits of the genus *Laticauda* possess "salt" glands that produce secretions rich in sodium and chloride ions. These secretions, although not as concentrated as those of the sea turtles and marine iguana are thought to remove excess salt from the blood (Dunson and Taub, 1967; Dunson, 1969; Burns and Pickwell, 1972). Therefore, rainfall is thought to have little effect on the biology of marine snakes (Gorman, *et al*., 1981). When kept in captivity in pure sea water, sea kraits become agitated (personal observations) and after a number of months become listless and die (Ditmars, 1962). Access to freshwater in captivity is conducive to their survival (West, 1990). The distribution of *Laticauda* (Heatwole, 1987) in large part coincides with the distribution of mean annual low salinity surface waters (Walton Smith, 1974) in the tropical Indian and Pacific Oceans i.e. from the Bay of Bengal to Niue in the Pacific Ocean and from the islands of southern Japan to New Guinea and the tropical waters of Northern Australia. Captive *Laticauda* drink fresh water (Dunson, 1969; West, 1990) and suggest that opportunistic drinking may occur at sea during heavy rain. Observations on the drinking behaviour of *Laticauda colubrina* in the wild are reported herein.

All observations on drinking behaviour were made on Sausau Island (16°16'South, 179°27'East) Fiji. Rainfall on the island is seasonal with the summer months (December - February) being the wet season. In the 80 days prior to my visit in July 1981, a total of 45 mm of rain had been recorded at Vavalagi (6 km to the south on Vanua Levu). A grass fire had killed 35 *L. colubrina* and the remainder of the terrestrial vegetation was tinder dry. On 9 June light rain fell at 2000 and continued for approximately 1 hour during which time 22 *colubrina* emerged from the vegetation and moved not to the sea, but moved about in what I initially thought was an aimless manner. Many were tongue flicking at blades of grass, twigs and the fallen leaves of coconuts. It was not until I encountered snakes actually drinking by gulping rainwater from the depressions in coconut leaves that the reason for their behaviour became apparent. The drinking behaviour continued into the night with most activity ceasing by 2400. An adult male at 2240 was observed for several minutes drinking from a depression in a coconut leaf. The rhythmic contractions of the neck were recorded at 14 in 20.3 s, 20 in 26.8 s and 30 in 52.5 s (air temp. = 23°C, water temp. = 21.5°C). The following day was clear and sunny (max. air temp. = 30°C) resulting in the evaporation of the previous night's rainwater. After sunset there were few snakes moving (18 snakes from 1900 to 2400). At 0115 that night an adult male *L. colubrina* was located amongst the leaves of a leguminous creeper on a rock face. The snake was tongue flicking at the moisture that had exuded onto the leaves (Fig. 1). I poured several drops of freshwater down a leaf that the snake was investigating which increased the tongue flicking behaviour without otherwise disturbing the snake. Snakes were seen tongue flicking at dew drops on dried grass leaves in the early morning (0700) and they regularly investigated the leaks and spills from the water containers at my camp-site.

During the wet season, January 1982, I returned to Sausau Island. Heavy rain fell most days and surface freshwater was plentiful on the island. During torrential rain at 1700 on 9 January (air and rain temp. = 27°C), an adult female *L. colubrina* was found about 1m above the ground in a small shrub. The anterior half of her body was hanging near vertically as she drank rainwater from leaves and the water that was running forward along her body. During the same

down-pour two adult males were seen drinking from depressions and three others had their heads raised above the ground tongue flicking at raindrops.

The above observations on drinking behaviour are similar to those reported for the American mangrove water snake *Nerodia fasciata compressicauda* (Miller, 1985). The collecting of rainwater from the lips by lowering the anterior part of the body while elevated above the ground is an unusual behaviour for an aquatic snake. Tongue flicking at moist surfaces and raising the head during heavy rain are previously unrecorded for a sea snake and raises the question of the antiquity of such behaviour amongst snakes. Although possessing glands capable of salt secretion, *L. colubrina* drinks fresh water when it is available and behaves in a way that enables it to collect rainwater from its body and other surfaces. The generalisation that rainfall is unlikely to affect marine snakes (Gorman *et al.*, 1981) requires closer investigation.

ACKNOWLEDGEMENTS

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REFERENCES

Burns, B. and Pickwell, G.V. (1972) Cephalic glands in sea snakes (*Pelamis, Hydrophis and Laticauda*), *Copeia* 1972 (3):547-559.

Ditmars, R.L. (1962) *Snakes of the World.* Pyramid Publications, Inc. New York.

Dunson, W.A. (1969) Electrolyte excretion by the salt gland of the Galapagos marine iguana, *Am. J. Physiol.* 216(4):995-1002.

Dunson, W.A. and Taub, A.M. (1967) Extrarenal salt excretion in sea snakes (*Laticauda*), *Am. J. Physiol.* 213(4):975-982.

Gorman, G.C., Licht, P. and McCollum, F. (1981) Annual reproductive patterns in three species of marine snakes from the central Philippines. *Journal of Herpetology* 15(3): 335-354.

Heatwole, H. (1987) *Sea Snakes.* University of New South Wales Press, Sydney.

Miller, D.E. (1985) Rain water drinking by the mangrove snake *Nerodia fasciata compressicauda. Herp. Review.* 16(3): 71.

Walton Smith, F.G. (1974) *Handbook of Marine Science.* CRC Press, Cleveland, Ohio.

West, J.(1990) The biology of captive sea snakes. *Herpetofauna* 20(2):28-31.

Figure 1. *Laticauda colubrina* drinking from leaves

NOTES ON THE NESTING,INCUBATION AND HATCHING OF THE SOUTHERN ANGLE-HEADED DRAGON, *HYPSILURUS SPINIPES* (SQUAMATA: AGAMIDAE)

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ABSTRACT

Observations on nesting of a single female Southern angle-headed dragon *Hypsilurus spinipes* showed that three shallow depressions (trial nests) were dug by the female prior to egg deposition in the fourth depression. The final nest site was only exposed to the sun for 25-30 minutes per day. Six eggs were laid, with an average weight of 2.1 grams. Three were deposited in the shallow depression which was partially covered with soil; two eggs were totally exposed on the leaf litter some 2.8 metres away; and a sixth was laid during handling three days later.

Incubation time was 73-75 days with a hatching rate of 66%. Temperatures in the nest were recorded at various times during the incubation period. Hatchlings were 32.5-34mm snout-vent length and 83-85mm total length. All hatchlings that were encountered exhibited the response of aggression to slow movements and freezing to sudden movements.

INTRODUCTION

Nesting behaviour, incubation temperatures and hatching times have not been documented for *Hypsilurus spinipes* around the Coffs Harbour region.

On November 30, 1990 a search was carried out in Wild Cattle Creek State Forest, NSW. (30°10'S 152°47'E) to locate and photograph *Hypsilurus spinipes*. Six individuals were found, three were female, only one was gravid.

Following the observations of Shea et al (1991) on the egg deposition of *H. spinipes* in the Barrington Tops region of New South Wales, it was thought that the egg deposition should occur within a week.

MATERIALS AND METHODS

A spool of nylon thread was attached to the gravid female with paper based surgical tape (3M Micropore). The spool pack was taped to the tail 5cm distal to the cloaca, to eliminate the possibility of the spool pack hindering egg deposition.

The female was then released at the capture site within 15 minutes of initial capture and her movements monitored over the next two days, during which time egg deposition occurred. To minimise possible stress no temperature readings were taken of the animal.

The two eggs laid away from the nest site were placed with the other eggs which were measured and weighed, then covered with a layer of soil, leaf litter and wire mesh to prevent possible predation from brush turkeys *(Alectura lathami)* and lace monitors *(Varanus varius)* both of which are plentiful in this area.

Observations were made at the nest site to establish the duration of sun exposure. A thermistor probe was used to measure the early morning, midday and afternoon temperatures over a range of weather conditions (Table 2).

RESULTS

The movements of the gravid female prior to egg deposition were mainly arboreal (71.4% of spool expended over 2 days) and consisted of movement on or along vines, logs and saplings (Figure 1). Only one observation was made of the female basking but interpretation of the spool trace suggested a further five basking sites.

Table 1. Weight of Female *Hypsilurus spinipes*

Date	Mass (g)	Notes
30.11.90	57	Female 2 days prior to egg deposition
02.12.90	46	Female after egg deposition
05.12.90	63	Female 3 days after egg deposition prior to depositing egg in my hand

Table 2. Nest Temperatures of *Hypsilurus spinipes* Eggs

Date	Weather Conditions	Times and Temperatures ± 1.1 °C		
		0730hrs	1200hrs	1500hrs
21.12.90	fine	18.6	18.7	19.2
12.01.91	overcast	17.7	17.7	17.8
14.01.91	fine	18.1	18.3	18.8
22.01.91	rain	17.5	17.5	17.6
02.02.91	rain/fine	17.8	18.2	18.8

On December 2, 1990 at 1400 hours (E.S.T.) the female's position was checked; she had only moved one metre from her sleep site and was still in the same sapling.

A rain shower occurred between 1405 and 1530 hours (E.S.T.), which was the first rain for approximately one month.

At 1630 hours (E.S.T.) the location of the female was checked. Either during or after the rain shower the female had moved to a clearing in the forest near a large tangle of logs and dug four shallow depressions. Each depression was roughly triangular in shape and ranged in size from 5-9cm along each side. The depth of each depression varied from 1-3cm. The first three depressions (trial nests) did not have eggs any deposited in them. The fourth depression contained three eggs which had been partially covered with soil and leaf litter (Figure 2a). The female then moved a further 2.8 metres and deposited another two eggs 10cm apart on the leaf litter (Figure 2b). No signs of leaf litter scratching were evident at this site. All eggs showed signs of dessication, which was more pronounced in the eggs deposited on the leaf litter.

The weight (mean 2.1 grams) and sizes (mean 22.9 x 13mm) of the eggs were measured at this time (Table 3). All eggs were relocated to the fourth depression and covered with 2cm of soil and leaf litter.

At 1640 hours (E.S.T.) the female was noted to be 11.8 metres from where the last eggs were deposited. The female was captured, weighed and released. The spool pack was left on for a further 3 days to determine if she would return to the nest area, but she did not. On December 5, 1990 the female was again captured so that her weight could be checked. A large increase in body weight suggested increased feeding following egg deposition (Table 1). During the removal of the spool pack an egg was deposited in my hand. This egg appeared normal but later proved to be infertile.

Measurements were taken of the temperature in the nest at various times. The incubation temperature range was 17.5 - 19.2°C (mean 18.1$\pm$ 1.1°C) (Table 2).

On the 14th February 1991 at 1130 hours, 74 days after egg deposition, the nest site was checked. Two eggs were found to have hatched and a further two other eggs were beginning to hatch. Observations of the emerging young were carried out over the next 7 hours. Activity

occurred in bursts of 10-15 minutes duration, followed by a period of inactivity of up to 2 hours. By 1730 hours one hatchling had totally emerged from the egg (Figure 3) but remained inactive with eyes closed. The second hatchling was approximately half out of the egg. The nest site was covered with soil at 1830 hours and reopened the following morning (0600 hours). At first both hatchlings appeared dead and one was picked up and handled. The body was very rigid, and manipulation of legs and head produced no response. The dragon was about to be placed in a bag for preservation when one eye opened. Slight pressure to the top of the head or slow movement in front of the eye evoked a mouth opening response.Sudden movement caused the eye to close and the rigid response which was observed initially.

Figure 1. Spool Trail of Female *Hypsilurus spinipes*

At 0900 hours on the 15th of February a hatchling (#,3, Table 4) was located on the leaf litter approximately 1.5 metres from the nest site. The yolk sac was still attached, so it may have been from the same nest. This individual exhibited the same range of responses to both slow and fast movements.

On April 3, 1991 another hatchling (#4, Table 4) was located on Moses Rock Road in Wild Cattle Creek State Forest approximately 10km south of the previous study area. The dragon still had a visible slit caused by the yolk sac, suggesting it was a recent hatchling. This individual also exhibited the same responses observed earlier.

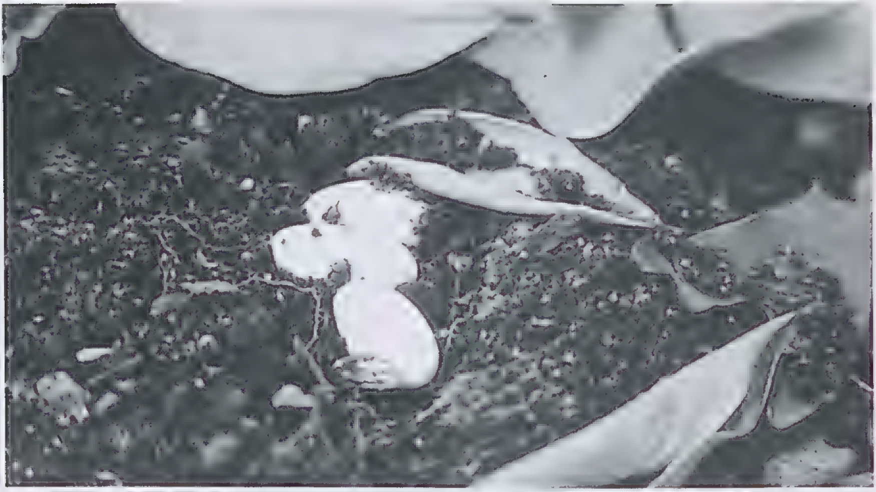

Figure 2a. Eggs deposited in Shallow Depression

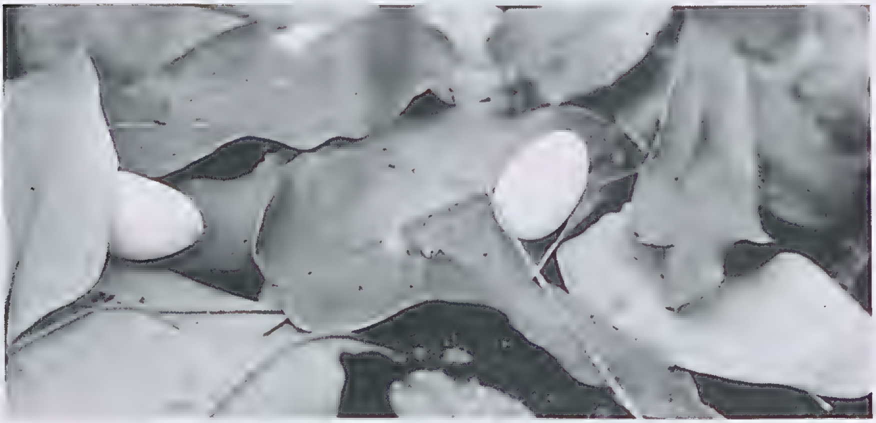

Figure 2b. Eggs deposited on Leaf Litter

Table 3. *Hypsilurus spinipes* Egg Sizes and Mass

Number	Length (mm)	Diameter (mm)	Mass (g)
1	23.1	13.2	2.1
2 *	22.4	13.1	2.0
3	23.1	13.2	2.1
4	23.7	13.5	2.2
5	23.2	12.9	2.1
6 *	22.1	12.5	2.0

* denotes infertile egg

CONCLUSION

The observations on nesting presented here, while based on only a single female are consistent with the observations of nesting and timing of oviposition for *H. spinipes* in the Barrington Tops region (Shea et al., 1991) and suggest that eggs may be deposited in shallow depressions, partly covered with soil. The large number of eggs left exposed at both Barrington Tops and in this study could be due to female inexperience or disturbance during egg deposition. More research is required into this unusual phenomenon.

The responses of *Hypsilurus spinipes* hatchlings to movement have not been documented previously, probably due to their small size, cryptic colouration and freezing behaviour (noted in this paper) which makes them extremely difficult to locate in the field.

The closing of the eyes and death-feigning behaviour has also been observed in other agamids; *Amphibolurus muricatus*, a young *Pogona barbata* (Frauca 1973)and the eastern water dragon *Physignathus lesueurii* (pers obs). Its value as a method of escaping predation has not been assessed.

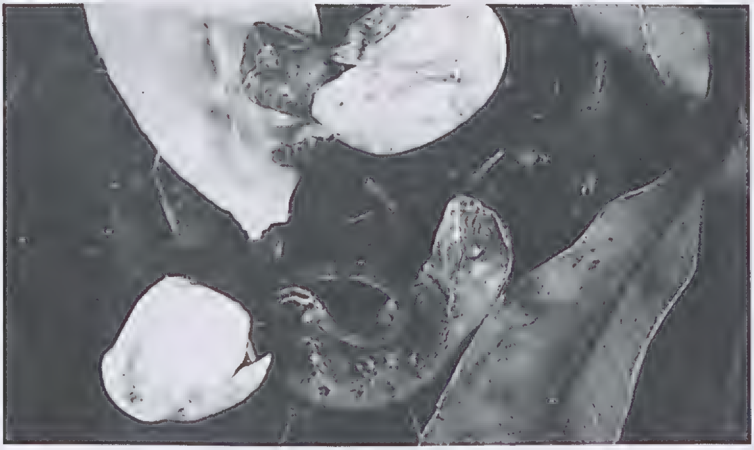

Figure 3. Eggs hatching

Table 4. Sizes and Weights of *Hysilurus spinipes* Hatchlings

Hatchling No.	Snout-vent Length (mm)	Tail Length (mm)	Weight (g)
1	33	51	2
2	33	50	2
3	34	51	2.1
4	32.5	52	2

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REFERENCES

Frauca H. (1973) *Australian Reptile Wonders* p. 19-20. Rigby Ltd. Sydney.

Shea G., Husband G. and Weigel J. (1991) Nesting of the southern rainforest dragon, *Hypsilurus spinipes* (Squamata: Agaminae) *Herpetofauna* 21(1).

A RECORD OF *DIPLODACTYLUS CONSPICILLATUS* IN NEW SOUTH WALES

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INTRODUCTION

Diplodactylus conspicillatus were observed and collected, confirming its presence in NSW and providing a precise locality record.

The site is located in far north western New South Wales close to the Paroo River at Wanaaring (Figure 1). The area is a plain of heavy red soil covered with Chenopod shrubs, grasses and Acacias (Figure 2).

OBSERVATIONS

In October 1988 I travelled to the Wanaaring region of NSW for the purpose of photographing *Diplodactylus ciliaris, Diplodactylus stenodactylus* and *Diplodactylus conspicillatus.*

While the Australian Museum had a number of specimens with accurate locations for the first two species, their sole record for NSW for the Fat-tailed Gecko had only "north western NSW" as a locality. This gave me no guide as to where it might be found.

The first day was spent looking for *D. ciliaris* between Wanaaring and Goorimpa station. Seven reptile species were observed: *Gehyra variegata, Oedura marmorata, Cryptoblepharus carnabyi, Pogona barbata, Ctenophorus nuchalis, Varanus gouldii* and *Pseudonaja nuchalis.*

Having failed to locate *D. ciliaris* I drove to a sandy region south of the Nocoleche Nature Reserve to search for *D. stenodactylus.* Four gecko species were observed within a period of one hour. These were: *Nephrurus levis, Lucasium damaeum, Heteronotia binoei* and *Gehyra variegata.* Having completed my activities at this location I returned to Wanaaring and set up camp approximately 2km south west of the town. I commenced spotlighting at 2200hrs and at 2300hrs my attention was caught by movement amongst some leaf litter at the base of a small shrub. The object was easily recognisable as *D. conspicillatus.*

It was approximately 45mm snout-vent length with light brown spots and markings on a medium brown upper surface and pale undersides. The regenerated tail was pale brown.

Despite searching until 2400hrs no further Fat-tailed Geckoes were seen.

One month later I returned to Wanaaring with Gerry Swan to locate further specimens of this gecko. Our search area was at the same spot the first specimen had been found. The evening was comfortably warm and we commenced spotlighting at 2500hrs, finishing at 0130hrs. During this time we found three *D. conspicillatus,* all males and two of which had original tails (Figure 3). Other species found in the same area were *D. ciliaris, D. steindachneri* and *Gehyra variegata.* The vegetation at this site varied from patches of shrubs and Acacias to open areas covered with herbs and grasses. All geckoes were found among shrubs.

DISCUSSION

There is insufficient data available to come to any definite conclusion about the distribution of *D. conspicillatus* in this state. However there have been reported sightings from just north of Wilcannia; the western side of Mootwingee National Park (unpublished NPWS data); and Sturt National Park (Swan 1990).

The first two would indicate a southerly and south westerly extension of the population at Wanaaring. Although I am unaware of any sightings east or due west of the Paroo River at Wanaaring no barrier appears to exist which would limit their expansion in these directions.

Figure 1. Map of NSW showing localities of *D. conspicillatus.*

Pianka 1976, strongly indicates that soil type, vegetation or terrain would be unlikely to restrict the distribution of this species. Why then have so few sightings been reported in NSW? Is it simply a lack of herpetological surveys in this region or could competition from other gecko species inhabiting the same ecological niche, restrict their distribution here?

Rhynchoedura ornata could be a competitor. It is widespread in western NSW, feeds almost exclusively on Isopterans (Pianka 1986), inhabits a broad range of habitat types and utilises the same daytime retreats (Pianka 1976). However despite all the similarities, both species are sympatric over a large portion of their range in other states (Pianka 1976). It therefore seems unlikely that competition from *R. ornata* would restrict the range of *D. conspicillatus.*

It is possible that this species is sensitive to habitat disturbance and that overgrazing has reduced a widespread population to pockets of relatively undisturbed land. Much more survey work will need to be carried out before we know the range of this species in NSW.

ACKNOWLEDGMENTS

My thanks to Gerry Swan for his support and assistance on this and other field trips.

REFERENCES

Pianka, E.R. and H.D. Pianka (1976) Comparative Ecology of Twelve Species of Nocturnal Lizards (Gekkonidae) in the Western Australian Desert. *Copeia* 1976:125-142.

Pianka, E.R. (1986) *Ecology and Natural History of Desert Lizards.* Princeton University Press, Princeton New Jersey.

Swan, G. (1990) *A Field Guide to the Snakes and Lizards of New South Wales.* Three Sisters Publications Pty. Ltd. Winmalee, New South Wales.

Figure 2. Habitat of *D. conspicillatus* at Wanaaring

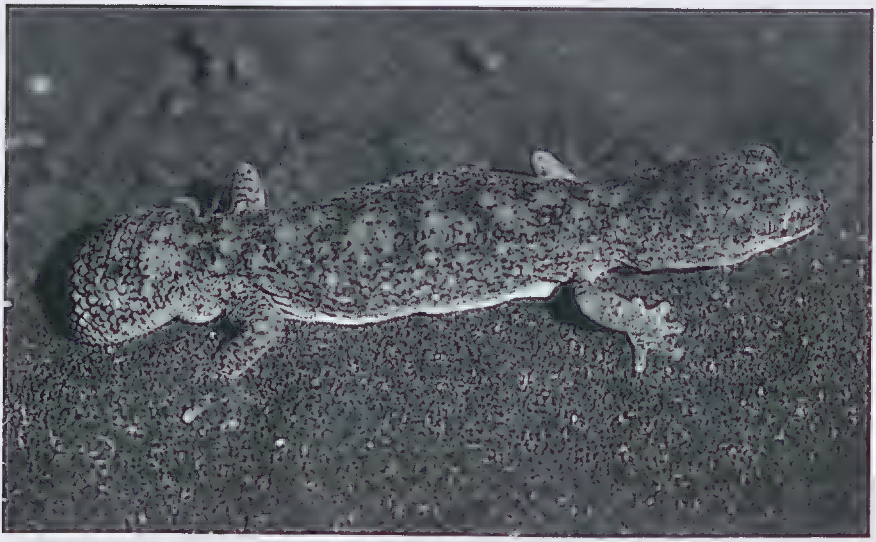

Figure 3. *D. conspicillatus* with original tail found in November 1988.

SOME SUGGESTIONS TO DECREASE REPTILE ROADKILLS IN RESERVES WITH EMPHASIS ON THE WESTERN AUSTRALIAN WHEATBELT

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In this article we highlight the destruction of native fauna, particularly reptiles, on our roads and offer suggestions to reduce this in nature reserves. In the Western Australian wheatbelt these are comparatively small areas of undisturbed bushland. The animal road deaths in these can have a considerable impact on local populations.

It is common for drivers on bitumen roads in bushland to see roadkilled native fauna. Dead animals are common on unsealed roads also but are not as readily observed. It is a fact that many mammals, birds and reptiles are killed while crossing roads. Of these faunal groups the reptiles are more at risk due to their basking habits, slower movement and inability to detect unnatural danger. Ehmann and Cogger (1985) estimate that five million reptiles and frogs are killed each year on Australian roads.

The numbers of reptiles and frogs killed on a long sealed road with continuous traffic flow is alarming, e.g. the Great Northern Highway from Perth to the north-west (approx. 3,000kms) extends through large areas of bushland rich in reptile fauna. In the north reptile activity continues throughout most of the year due to the climate. During two separate trips on the Great Northern Highway from Wubin to South Hedland, one of which also included a return trip along the North West Coastal Highway from Sandfire to Carnarvon, we found 396 specimens of 28 species roadkilled (see Table 1 below).

Table 1.

GECKOS		LEGLESS LIZARDS	
Diplodactylus c. aberrans	100	*Delma butleri*	1
" *conspicillatus*	86	" *nastuta*	1
" *stenodactylus*	30	*Lialis burtonis*	12
Nephrurus l. pilbarensis	1	*Pygopus n. nigriceps*	17
DRAGONS		**SKINKS**	
Ctenophorus inermis	30	Tiliqua multifasciata	3
" *i. isolepis*	21		
Pogona m. minor	3		
		MONITORS	
		aranus acanthurus	2
		" gouldi	10
		" p. rubidus	3
		" t. tristis	3
SNAKES			
Aspidites melanocephalus	6	Denisonia fasciata	4
" *ramsayi*	1	Furina ornata	1
Morelia perthensis	4	Pseudechis australis	23
" *s. stimsoni*	19	" butleri	2
Acanthophis pyrrhus	1	Pseudonaja modesta	3
Demansia rufescens	1	" nuchalis	8

Reptiles found dead on road (number in brackets) during two trips along the Great Northern Highway between Wubin and South Hedland, and one return trip along the North West Coastal Highway between Sandfire and Carnarvon, Western Australia. This list represents reptiles found dead during night travel. During the day scavengers remove most of the smaller reptiles.

The numbers killed are increased substantially wherever animals are forced from bushland by disturbance (both man-made or natural). Fire, flooding and land clearing are major factors that push animals onto roads. In the wheatbelt, because of widespread clearing for agriculture, the reserves are generally all that remains of the natural habitat for the terrestrial fauna. These reserves, in many cases they are no more than narrow corridors, are divided by bitumen roads which are a threat to the wildlife that remains there. From a conservation perspective the reserve is there for the indigenous flora and fauna. The very presence of a road in such a restricted and fragile pocket contradicts that purpose. Pressure is greatest on the larger reptiles as they need to forage further and therefore they include the road surface in their foraging area. Many drivers fail to see reptiles basking or moving on the road, and some drivers intentionally run over reptiles out of fear or ignorance. This unnecessary attitude often causes pecple to behave irrationally, e.g. incidents where vehicles were rolled over attempting to run over snakes (Bush, unpubl.).

The Department of Conservation and Land Management (CALM) whose responsibility it is to manage reserves appears to be doing this inadequately. Many reserves in the wheatbelt, for instance Lake Tooliban, Sir Charles Gardner, Buntine, West Bendering and Moondyne are divided by secondary roads and surrounded by agriculturally developed land. High mortalities on roads in these areas could be avoided by redirecting the roads around the perimeter of the reserve. We estimate this would reduce reptile deaths on roads by 50% and more in these reserves.

Less effective than rebuilding roads but financially more realistic would be the construction of deep culverts with low vertical walls along road edges. This would allow access to both sides of the road with the vertical walls drifting animals to culverts. Additionally, speed humps could be installed on secondary roads (inappropriate on main roads) to force drivers to slow down. These would need to be adequately sign-posted on the approach to a nature reserve with their purpose stated.

The least costly and also the least effective improvement in the management of these reserves would be the erection of informational signs on the approaching roads. These signs would advise motorists on the likelihood of native fauna on the road whilst passing the reserve. If done without one or more of the previous modifications suggested these signs are next to useless, and are no more than a high profile public relations exercise.

Burning, as a control measure to reduce the risk of wildfire, is often carried out in nature reserves, state forests and national parks. From a wildlife conservation perspective wildfire is natural, controlled burning unnatural. An often heard argument in favour of controlled burns is that "the aboriginal people did this for a long time with little detrimental impact". It must be remembered that after a pre-European burn there were peripheral areas of undisturbed bushland. This allowed the recruitment of animals back into the burnt area as its vegetation became re-established. This is not the case today - bushland is surrounded by cleared fields, the burn is usually total throughout the reserve and the impact significant.

If controlled burning must go ahead, then to limit the numbers of reptiles forced onto roads, it would be appropriate to do this in late autumn. Reptile activity is on the decline in late autumn in this region with many species that are less cold-tolerant already in deep below ground shelter, e.g. the agamids, varanids and large elapids.

Already many of the Western Australian wheatbelt reserves are considered more as flora reserves than fauna reserves. If something positive is not done shortly to improve their management then flora reserves are all they will be.

REFERENCES

Ehmann, H. & Cogger, H.G. 1985. Australia's endangered herpetofauna: a review of criteria and policies. In. *The Biology of Australasian Frogs and Reptiles.* (Eds. G.Grigg, R. Shine & H. Ehmann) pp.435-447. Surrey Beatty & Sons, Sydney.

SOME OBSERVATIONS ON THE BLOOD AND INTESTINAL PARASITES OF SNAKES IN SOUTH AUSTRALIA

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INTRODUCTION

Sixty snakes were captured by the junior author in summer and autumn from several areas of South Australia.

These snakes had both blood and faecal samples taken for a parasite investigation being conducted by P. O'Donaghue of the Institute of Medical and Veterinary Science in Adelaide.

The frequency of parasite infection and a brief outline of some of the effects of these parasites on snakes is detailed in these notes:

SNAKES SAMPLED	
Common Brown Snakes	11
Red Bellied Black Snakes	25
Death Adders	8
Curl Snakes	3
Western Brown Snakes	3
Carpet Pythons	8
Copperheads	2
	TOTAL = 60

60 faecal samples and 55 blood samples were obtained.

Some blood samples were not collected due to small snake size, poor condition of some snakes and the wish not to cause undue stress to some of the specimens being handled.

AREAS OF SOUTH AUSTRALIA SAMPLED

1. Mount Lofty Ranges. Two areas: a) Gawler area b) South-eastern Adelaide
2. Riverland
3. Yorke Peninsula
4. Whyalla
5. Far North

Parasites Identified

Protozoa: *Cryptosporidium. Eimeria. Sarcocystis: Haemogregarina. Haemosporidia.*

Nematodes: Spiruroids, *Kalicephalus.* Oxyurids, *Capillaria. Rhabdus.* Ascarids.

AREA DETAILS

1. Riverland

8 snakes sampled, (all carpet pythons).

Four of seven samples had blood borne parasites: Haemogregarina in three pythons and *Haemosporidia* in one python from the Loxton area. One had intestinal parasites *(Sarcocytis)*.

2. Yorke Peninsula

12 snakes sampled, (8 death adders, 4 eastern brown snakes).

No blood parasites were detected, but two snakes (death adders) had intestinal parasites. The infected adders were from the Tiddy Widdy Beach on northern Yorke Peninsula. These adders were infected with both protozoal and helminth parasites *(Eimeria, Capillaria, Kalicephalus)*.

3. Mount Lofty Ranges

a) Gawler area: 21 snakes, all Red-bellied black snakes

No blood parasites were detected, but 17 snakes had intestinal parasites, 14 with Spiruoid infections, 4 with protozoal infection *(Cryptosporidium, Sarcocystis)*.

This is believed to be the first recording of *Cryptosporidium* infection in a wild population of snakes. The snakes infected were in poor body condition. Whether this was due to the *Cryptosporidium* infection or some other reason is yet to be investigated.

b) South-eastern Adelaide: 13 snakes caught - 7 eastern brown snakes, 2 copperheads, 4 red-bellied black snakes.

None of the snakes sampled had blood parasites detected.

4 snakes had intestinal parasites detected:
1 brown snake with an ascarid infection
1 red-bellied black snake (caught in the Clarendon area) with *Cryptosporidium*
1 red-bellied black snake with a spiruroid infection
1 copperhead with an *Eimeria* infection

4. Whyalla Area

3 snakes sampled, all western brown snakes:

None had blood parasites detected, one had an *Eimeria* infection.

5. Far North

3 curl snakes.

Blood smears were not examined.

None had detectable intestinal parasites.

The statistical significance of these findings was not determined because of the small size of the samples. The existence of these infections in wild populations should be investigated further to determine the frequency and spread of the infections. The long term effect on wild populations could then be more accurately determined.

SOME EFFECTS OF THESE PARASITES IN SNAKES

Nematodes

Oxyurid infections are common in captive reptiles and rarely cause concern. While large burdens in the colon can result in severe diarrhoea, Oxyurid infections in wild snakes are probably of little worry.

The strongyle hookworm *Kalicephalus* is common in captive snakes. It has a direct life cycle but has never been observed in large infestations. It may be of significance in debilitated animals.

Ascarid worms often exist in large numbers in captive snakes but are easily eliminated with anthelmintics. In some cases ulceration and perforation of the gut has been recorded. The occurence of this in wild populations has not been investigated but may be cause for concern.

Rhabdins is one of the lung worms of captive reptiles and its existence in the wild is noteworthy as it is significant cause of pneumonia.

Protozoa

The pathogenicity of *Eimeria* infection is thought to be very low in captive snakes. Infections in the wild are probably not a cause for concern.

The Haemoprotozoa *(Haemosporidia, Haemogregarina)* are common blood parasites. Heavy infection in snakes can cause anaemia and occasionally liver necrosis. Their occurrence in these wild snakes is not considered a problem but further investigation may clarify this.

Cryptosporidium infection causes hypertrophic gastritis. No completely successful treatment has been found yet and infected snakes have a very poor prognosis. Transmission from snake to snake is by ingestion of oocysts. It is important to realise that this disease is a zoonosis and strict personal hygiene should be used when handling snakes suspected of being infected with *Cryptosporidium*. Captured wild snakes that have been shown to be infected with *cryptosporidium* should probably not be released as this parasite has the potential to severely affect snake populations.

BOOK REVIEW

"SNAKES OF MEDICAL IMPORTANCE (ASIA - PACIFIC REGION)"

Editors: P. Gopalakrishnakone and L.M. Chou

From time to time one is privileged to read a text of special worth. In this new publication "Snakes of Medical Importance (Asia - Pacific Region)", a series of some twenty eminent authors have contributed an overview of snakes and snakebite,in a part of the world where snakebite is of great medical significance.

The book is authoritative, comprehensive, total, and in many respects represents the "State of the Art" on this subject in the Asian-Pacific Region.

The book is superbly illustrated. There are spectacular colour photographs, and for many who are not privileged to travel and visit in the many beautiful areas of the world portrayed in the book, the coloured illustrations are stunning. The picture of cobras, kraits, vipers and other medically important snakes, together with their dramatic medical effects, have not been better portrayed in other currently available publications.

The book is extensively referenced, and contains all the details that a professional herpetologist would need, is a superb practical and reference text for the amateur herpetologist, and is a "must" for all those involved in the health care of victims. I recommend the book without reservation - it is a spectacular addition to the literature of herpetology.

Professor John Pearn
Professor of Child Health,
University of Queensland
and Director Training,
St John Ambulance Australia

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HERPETOLOGICAL NOTES

POSSIBLE "DOUBLE CLUTCHING" IN *STROPHURUS CILIARIS*

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Geckoes are generally thought to lay 2 eggs each breeding season, usually in a single clutch. In temperate areas, this generally follows spring mating and the eggs are deposited in late spring / early summer (Nov - Jan). *Strophurus spinigerus* has been reported to contain 3-4 eggs with eggs of differing stages in the same oviduct, suggesting that 2 clutches may be laid each season, each containing 2 eggs (Dell and Chapman, 1977 cited in Greer 1989). Indirect evidence in support of double clutching in *Strophurus ciliaris* is presented here.

On 6 October 1989 a gravid wild specimen of *Strophurus ciliaris* from Alice Springs laid 2 eggs, each measuring 12 x 5mm. The eggs were incubated in moist vermiculite at 27-28°C and hatched after 73 days (1 egg failed to hatch) on 18 Dec 1989. The successful egg had grown to 28mm in length when measured 3 days before hatching. The hatchling had a total length of 52mm (P. O'Grady pers. comm.). This period of egglaying and birth is the normally expected range for a wide range of squamate species in this area.

On 10 March 1991 at 20.15 hours, 2 gravid *S. ciliaris* were found "basking" on a bitumen road near Alice Springs. No other geckoes (of any species) had been seen in nearby areas during a 3 hour search. It was assumed the lizards were attracted by the heat holding road surface. One gecko was accidentally killed by a motor vehicle and the body and one egg were severely damaged; the remaining egg was recovered and measured 15 x 9mm. Both eggs had well developed egg shells. Given the incubation period of the "normal" clutch during summer, this clutch, if laid soon after this observation, would have hatched during May or June. This would have been at a cold time of the year and the young geckoes would not have been able to feed. It may be possible that the development of the eggs is slowed and they do not hatch until the following spring.

The 1990/91 summer was characterised by a hot dry spring and early summer followed by hot humid conditions after rains in January and February. The rain increased insect activity dramatically, providing ample food for insectivorous reptiles. It is possible that the "normal" period of reproduction was missed due to some unfavourable factor but this is unlikely given that other gecko species in the area were breeding normally at this time. It would appear as though the *S. ciliaris* in the area have responded to the abundant food supply by having a second reproductive period in the one season. However it is not known if these geckoes store sperm from one mating to produce more than one clutch.

ACKNOWLEDGMENTS

Thanks are due to Peter O'Grady for his information on the reproduction of *S. ciliaris*.

REFERENCES

Dell, J. and Chapman, A. (1977). Reptiles and frogs of Cockleshell Gully Reserve. *Rec. West. Aust. Mus. Suppl. No.4*:75-86.

Greer, A. (1989). *The Biology and Evolution of Australian Lizards.* Surrey Beatty and Sons, Chipping Norton, NSW.

NOTES ON THE DIET OF THE YELLOW-FACED WHIP SNAKE *DEMANSIA PSAMMOPHIS PSAMMOPHIS* IN THE KAMBALDA REGION OF WESTERN AUSTRALIA

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The diet of *Demansia psammophis* has been noted previously in the literature and Shine (1980) lists the published data for the *Demansia* species. This study, involving specimens from Western Australia, largely conforms with Shine's findings.

The study was based upon data obtained from road-killed specimens collected in the Kambalda region plus two specimens killed by domestic cats. All were collected within a 20km radius of Kambalda East (31°12'S 121°40'E). A total of fifteen specimens were examined between September 1985 and November 1990. Of these, seven (47%) contained prey items (see Table 1). The remaining eight (53%) contained no apparent prey items.

Table 1. Stomach Contents of *Demansia psammophis psammophis* in the Kambalda Region

DATE	TOTAL LENGTH (mm)	SNOUT-VENT LENGTH (mm)	STOMACH CONTENTS
26/09/85	720	550	N.A.*
?/03/86	660	510	Remains of two *Morethia* sp; tail of *Morethia* sp.
?/03/86	770	585	Tail of *Delma* sp.
03/04/86	626	518	N.A.
12/11/86	847	667	N.A.
28/01/87	615	490	Remains of: *Morethia? sp., Menetia greyii, Ctenophorus reticulatus?*
29/03/87	683	531	N.A.
12/04/87	800	600	*Morethia butleri*; two tails of *Gehyra variegata*; unidentified lizard tail
09/02/88	600	470	*Menetia greyii*; remains of *Ctenotus* sp.
07/11/88	715	555	N.A.
15/01/89	660	515	Two *Lerista muelleri*; three scincid tails
16/09/89	635	485	N.A.
14/02/90	620	476	N.A.
04/10/90	665	515	Remains of three *Lerista muelleri*
11/11/90	765	620	N.A.

* N.A. = None Apparent.

All prey items were lizards with skinks predominating. This reflects the findings of Shine except for frogs. Shine found that frogs constituted 7% of the diet for *D. psammophis*, but no frogs were recorded in this study. This could be due to the small sample size or alternatively, could reflect the climate of Kambalda. Kambalda has a semi-arid climate with most rain occurring in the winter months (Read, 1987). Consequently most frog activity occurs at this time, when *D. psammophis* is inactive (pers. obs.).

From my observations *D. psammophis* appears to be entirely diurnal in the Kambalda region and this is reflected in the diet. The nocturnal lizards recorded as prey items may have been encountered at rest during the day.

REFERENCES

Read, I.G. 1987. *The Bush. A Guide to the Vegetated Landscapes of Australia*. Reed Books Pty. Ltd., French's Forest, NSW.

Shine, R. 1980. Ecology of Eastern Australian Whipsnakes of the Genus *Demansia*. *Journal of Herpetology* 14(4): 381-389.

ADDITIONAL NOCTURNAL SIGHTINGS OF THREE SPECIES OF DRAGON LIZARD IN NORTHERN AUSTRALIA

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Greg Fyfe (1981) described nocturnal sightings of two species of dragon lizards whilst on a trip in Northern Australia. The species he saw were *Diporiphora sp.* and *Tympanocryptis cephalus.* (Although personal communication with Greg Fyfe suggests that the *Tympanocryptis* was actually *T. lineata.*)

While in the Northern Territory I also noted a number of dragon species which were active on warm nights. The animals I found were all active, and on a few occasions foraging, on relatively moonlit nights, and mostly within 24 hours after rain.

In January 1989 on a trip to Kununurra, Western Australia, I found two *Diporiphora magna* at 10:30pm within 100 metres of each other. The animals were active on the Experimental farm road, which at the time was still wet. In December 1989 I found a number of *Diporiphora bilineata* active until as late as 11:00pm whilst on holidays in Kakadu. Two animals were found on the short stretch of road from the Kakadu Highway to Noarlangie Rock (12°51'S, 132 °52 'E). A few days later whilst travelling home from Cahills Crossing on the East Alligator River, I watched another large *Diporiphora bilineata* consume a large moth on the road in the headlights of my car, the time was approximately 8:30pm.

In April 1990, while travelling through Litchfield National Park I saw an adult male Gilberts Dragon *(Gemmatophora gilberti)* active on the road, I estimate the time was between 8:00 and 9:00pm.

Although the total number of dragons seen active at night is small when compared to the number active during the day, it may be found that there is a direct association between nocturnal activity in dragon lizards and warm, wet moonlit nights in Northern Australia.

REFERENCES

Fyfe, G. (1981) Nocturnal sightings of two dragon species. *Herpetofauna* 13(1): 34.

UNUSUAL BASKING BEHAVIOUR IN CAPTIVE BEARDED DRAGONS *(POGONA BARBATA)*

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Two fourteen month old, captive hatched Bearded Dragons *(Pogona barbata)* are currently maintained in an inside enclosure measuring 2400mm x 900mm x 600m high with two adult Shingleback skinks *(Tiliqua rugosa)*. The substrate consists of a layer of dry mulched eucalyptus branches and the inhabitants are supplied with raised basking sites in the form of rocks and branches. Light and heat are provided by two 150 watt white spotlights plus a single 4 foot fluorescent fitting containing an F40T9BL "black light" tube. All are suspended 500mm above the substrate, although the lizards can move closer by climbing onto the basking sites. The enclosure is housed in an air conditioned room which produces a heat gradient of 36° - 37°C directly beneath the spotlights to around 23° - 24°C in the coolest corner. The lights are controlled automatically by an electronic timer to simulate the local natural photoperiod. These lizards have been maintained inside with no access to direct sunlight for at least ten months with no apparent health problems.

For a period of three days in mid January 1991 all four lizards were removed to a 900mm x 300mm x 400mm glass tank while their permanent enclosure was thoroughly cleaned. A wooden lid covered with insect mesh and 12mm weld mesh for ventilation was fitted to the top. An incandescent light fitting was situated in the middle of this lid and contained a 75 watt white bulb. Rocks were placed directly beneath the bulb allowing the lizards to bask within 200mm of the light. Unfortunately no temperatures were taken in the enclosure but an estimation would be about 25° - 28°C.

When returned to their permanent enclosure both dragons were placed on separate rocks, directly beneath each of the spotlights. Within a minute of being placed there both lizards were observed with their heads pointing directly at the spotlights and their mouths wide open. This position was maintained for around 30 - 60 seconds before normal orientation and behaviour was resumed. No unusual behaviour was observed by either of the two Shinglebacks at any time.

Although the literature contains numerous references to Bearded Dragons posturing to maximise thermoregulatory efficiency, these usually refer to simple orientation of the body to increase exposed surface area and/or change in colouration. Greer (1989) cites several references of dragons displaying open mouths but these appear to refer to lizards undergoing heat stress and panting in an attempt to reduce body heat.

Greer also goes on to describe a physiological mechanism by which dragons control their body temperature by changing the patterns of blood flow. When basking first begins blood may be shunted to the head probably to heat the important areas of the brian and sensory organs. A similar process may also occur in the dorsal mid-body region.

A possible explanation for the observed behaviour is that the two Bearded Dragons had been maintained at a lower body temperature for an extended period of time (3 days) and thus when sufficient heat was supplied they attempted to increase their body temperature towards their preferred body temperature as quickly as possible by exposing the highly vascularised mouth lining directly to the heat source. The efficiency of this technique may have been further enhanced by the blood shunting mechanism mentioned above.

REFERENCES

Greer, A.E., 1989 *The Biology & Evolution of Australian Lizards.* Surrey Beatty & Sons Pty Ltd, NSW 2170.

ARBOREALITY IN THE SKINK *SPHENOMORPHUS FUSCICAUDIS*?

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Zoology A08, University of Sydney, NSW 2006

During January 1991 whilst walking in the rainforest around Lake Barrine, a volcanic lake on the Atherton Tableland in northeastern Queensland, we discovered a large skink approximately 2m up a tree. The tree was approximately 30cm in diameter, had moderately rough bark and was essentially perpendicular to the ground. On capture, the skink proved to be an adult *Sphenomorphus fuscicaudis* (Fig. 1). What is unusual about this discovery is that this species and others of its species group are generally considered to be terrestrial (Cogger, 1986; Wilson and Knowles, 1988).

S. fuscicaudis is a large, moderately attenuate skink with relatively short limbs (Greer, 1979). This body form is commonly associated with fossorial species (Greer, 1989). At present it is unclear precisely what the skink was doing up the tree and whether or not arboreality is characteristic of this species. Hopefully further observations will provide an explanation for this puzzling behaviour.

REFERENCES

Cogger, H.G. (1986). *Reptiles and Amphibians of Australia.* Reed, Sydney.

Greer, A.E. (1979). A new *Sphenomorphus* (Lacertilia: Scincidae) from the rainforests of northeastern Queensland. *Rec. Aust. Mus.* 32: 373-383.

Greer, A.E. (1989). *The Biology and Evolution of Australian Lizards.* Surrey Beatty, Chipping Norton.

Wilson, S.K. and Knowles, D.G. (1988). *Australia's Reptiles.* Collins, Sydney.

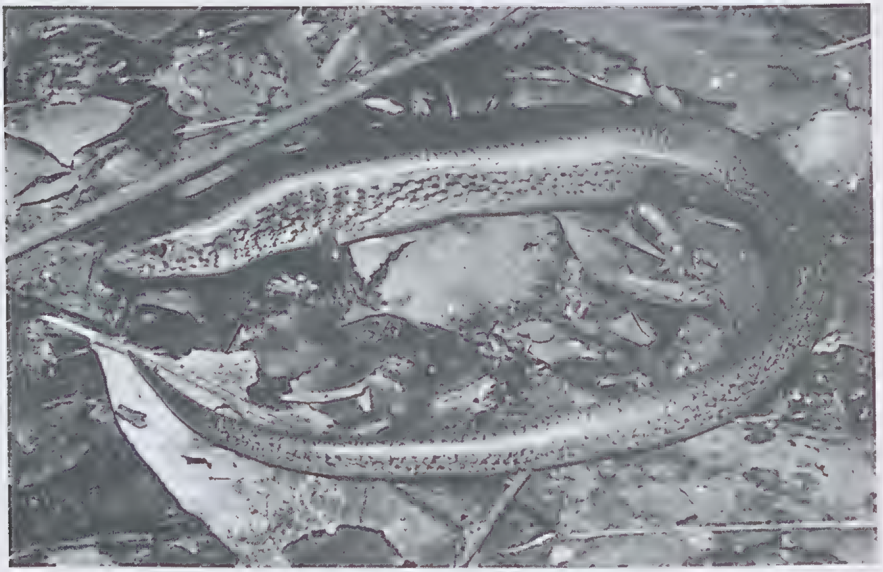

Figure 1. *Sphenomophus fuscicaudis*

SNAKES SWALLOWING THEIR OWN TEETH

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Although it is known that teeth are replaced in snakes, (Hoser, 1989) neither the rate at which this occurs or what happens to the replaced teeth appears to have been documented. Casual observations by the authors indicates a high rate of tooth loss in snakes, particularly non-venomous varieties and that large numbers of teeth are ingested by snakes when feeding.

In his work at Taronga Zoo (Sydney) one of the authors (C.W.) had the opportunity to inspect the faeces of a number of snakes. Each faeces was carefully checked for discarded teeth. Five samples from Reticulated Pythons *Python reticulatus* averaged ten undigested teeth, with the maximum number of teeth found in a single faeces being about twenty. A similar number of teeth were found in three faeces of Scrub Pythons *Morelia amethistina*. Faeces from *Taipan Oxyuranus scutellatus* and Death Adder *Acanthophis antarcticus* which were inspected contained few if any teeth. Eastern Diamondback Rattlesnake *Crotalus adamanteus* faeces were also inspected and although teeth were regularly found, the number was not as high as for the pythons.

In the period 1977-84 one of the authors (R.H.) noted on some occasions the presence of fangs in the faeces of Death Adders *Acanthophis antarcticus*. These fangs were only ever seen singly and although when seen they were noted, no attempt was made to closely inspect faeces for fangs. Death Adders commonly shed fangs when being milked for venom during the period 1977-84, although it was noted that fangs were only shed when replacement fangs were in place.

It is well known among herpetologists who are bitten by snakes, particularly non-venomous varieties such as Pythons and Green Tree Snakes *Dendrelaphis punctulatus* that these snakes have a propensity to leave teeth in the flesh of the bitten person. It would be reasonable to assume that this also occurs when these snakes strike at prey items, thereby resulting in the ingestion of teeth with the prey.

It appears that the number of teeth likely to be found in a snake's faeces is proportionate to the number in the snakes mouth. The high number of teeth found indicates perhaps a higher rate of teeth replacement than may have been suspected.

Although it seems that ingested teeth are usually passed through without a problem, Ron Sayers (pers. com.) reported a case of Gaboon Viper *Bitis gabonica* that was found dead after a large fang had perforated the stomach lining. Such problems are presumably most likely to occur in large-fanged venomous snakes.

We are uncertain if non-venomous snakes only shed teeth when replacement teeth are present (as in elapids).

REFERENCE

Hoser, R.T. (1989) *Australian Reptiles and Frogs*. Pierson and Co., Sydney.

NOTES ON CAPTIVE BREEDING OF *LITORIA ALBOGUTTATA* (ANURA: HYLIDAE)

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SPECIMENS

Both adults were purchased at the Grace Brothers Pet Shop, Broadway, Sydney in March/April of 1991. The male (65mm snout-vent length) and is a light tan generally, with a green stripe down the centre of his back. Other markings are as described by Robinson (1991). The female (70mm SVL) is almost black in colour, but when she does lighten up she is a dark brown and her stripe is green between her eyes, changing to a pale brown down her back and then back to green toward her cloaca.

The pet shop was unable to provide me with details of where the specimens may have been obtained from.

KEEPING CONDITIONS

They are kept in a 900 x 350 x 500mm aquarium in my bedroom, which has an average-sized window which faces south. The tank has approximately 150mm of permanent water. One end of the tank has a large weathered sandstone rock with large holes in it laid horizontally. Some of these holes have loosely planted *Spacophylum* and *Diffenbachia* plants in them. There is a layer of 25mm of gravel as substrate on the bottom of the tank. The water is kept clean by a 1.5 litre external filter that takes water from one end of the tank and returns it via a spray tube down the back wall on the other end of the tank. "Daylight" is provided by a "Growlux" fluorescent tube which is on a timer that comes on at 0745 and goes off at 2045 each day. The temperature of the water is maintained at 27 degrees celsius, and as the tank has glass lids, the air temperature is similar. The *Litoria alboguttata* share the tank with 6 adult *Litoria caeulea.*

METHOD

In an attempt to induce the *L.caeulea* to breed, I adjusted the spray from the filter return tube back into the tank to simulate rain. *L. alboguttata* which had up to this time been quiet and secretive, became active and quite visible at most times of the day and night. The male's nuptial pads became quite enlarged and dark. Also his throat became dark, the normal coloration (ie. brown and white marbling) went almost solid black.

The only calls I had heard up to this time were a soft, quacking type, up to 5 short notes (Robinson 1991). There did not seem to be any increase in the frequency or volume of calls after the development of the secondary sexual characteristics.

On the morning of Sunday 27th October 1991 at approximately 0400 I discovered the two in axillary amplexus. I did not approach the tank at this stage so as not to disturb them. When I got up later that morning I discovered the bottom of one end of the tank covered in a sheet of tiny black eggs. The eggs appear to have been laid in a sheet over the submerged rocks and substrate. This sheet was not continuous, there were also loose single eggs and smaller sheets. There were six other frogs (apart from the parents) in this tank, so they may have contributed to a break-up of a possibly larger sheet, although this was not observed. One section seemed to have had 2 or 3 layers on top of each other. The adults were no longer in amplexus.

I removed some eggs into an open-topped container and kept them at room temperature.

In approximately 20 hours the eggs in the main tank had reached the tail bud stage of development (Gosner, 1960). In less than 36 hours, all live eggs had hatched and were free swimming with external gills. The eggs I removed were a full 24 hours behind in development. Loss rate in the main tank was approximately 25%, mainly in the section that was laid 2-3 layers on top of one another and the eggs I removed had a 50%-75% loss rate. I did not count the number of eggs laid, but I estimate between 200-500.

In less than a week the male frog had lost all secondary sexual characteristics but both frogs have remained active both day and night. During all this, the frogs have been fed large cockroaches and some mealworms. I have repeated these conditions many times. The male gains some colour on his throat and pads, but not as dark as at the time of oviposition.

ACKNOWLEDGMENTS

Martyn Robinson, Australian Museum for positive identification and Harald Ehmann for help with the final draft.

REFERENCES

Tyler, M.J. (1989) *Australian Frogs.* Viking O'Neil. Penguin Books.

Robinson, M. (1991) *Frog Watch Field Guide.* Australian Museum.

Gosner K.L . (1960) A simplified table for staging anuran embryos and larvae with notes on identification, *Herpetologica 16:* 183-190.

RECORD OF ROAD KILL PREDATION BY THE FRESH WATER SNAKE *(TROPIDONOPHIS MAIRII)*

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Although the generic placement of the Fresh Water Snake *(Tropidonophis mairii)* has changed over the past six years, moving from *Amphiesma* in Cogger (1986) to *Styphorynchus*, Wilson and Knowles (1988) and recently to *Tropidonophis*, Swan (1990), the diet of this animal has never been in question. All the aforementioned authors agree that this animal feeds extensively on frogs. Until now it has been assumed that these reptiles caught and consumed live prey only. My recent observations reveal that this is not always the case.

During a rain storm on the Arnhem Highway at the Adelaide River Overflow, west of Beatrice Hill prison (12 °38'S, 131° 18'E) early in January 1990 at approximately 8:00pm, I observed the movement of many hundreds of frogs onto the highway. Most frogs were identified as *Litoria dahlii*, but other species included *Litoria nasuta, L.tornieri, L.bicolor, L.caerulea, L.wotjulumensis, L.rothi, Cyclorana australis, C.longipes, Lymnodynastes convexiusculus* and *L.ornatus.* Tyler and Davies' (1986) publication was used.

This road across the overflow is about 1 kilometre in length. With such a high number of frogs traversing the roadway and the large number of cars which travel the Arnhem Highway every day, to and from Kakadu, it is no wonder that there is an extremely high mortality rate. This carnage is magnified during wet weather. I estimated that after 5 minutes of rain (with 20 to 30 cars having crossed the overflow) there was an average of one frog to every square metre over the full kilometre of overflow roadway.

During the downpour I observed a number of snakes coming onto the roadway, but rather than pass from one side to the other, it was obvious that these animals were in fact foraging on the roadway. Of the animals I observed, three Fresh Water Snakes ate dead frogs, in fact a few of the dead frogs consumed were well pressed into the bitumen. This required the snake to open its mouth and dig its bottom jaw under the frog to extricate the frog from the bitumen. It was noted that all dead frogs eaten from the roadway were *Litoria dahlii* or remnants of this species. It was amusing to see a number of frogs jump on and around the snakes as they foraged for frog carcases. The snakes appeared not to be distracted by the frogs as they systematically searched the roadway.

When the rain ceased after approximately half an hour, the snakes which had been feeding vanished, with only transient snakes being seen for the rest of the night. No further animals were seen feeding on either dead or live frogs. About one month later, in early February, I observed the same phenomenon. Once again Fresh Water Snakes were feeding on road killed *Litoria dahlii* in the rain. It should be pointed out that the mortality rate of Fresh Water Snakes is also high in this area, it is possible on occasions to see up to a dozen dead snakes while crossing the overflow.

The question that these observations raises is whether this feeding strategy is widespread in this snake, or is it peculiar to this area? I have not observed this behaviour elsewhere although I have not seen snakes in other areas in the same numbers nor subject to the same climatic conditions.

REFERENCES

Cogger, H.G. (1986) *Reptiles and Amphibians of Australia.* Reed Pty Ltd.

Swan, G. (1990) *A Field Guide to Snakes and Lizards of NSW.* Three Sisters Productions Pty Ltd, NSW.

Tyler, M.J. and Davies, M. (1986) *Frogs of the Northern Territory.* Conservation Commission of the N.T.

Wilson, S.K. and Knowles, D.G. (1988) *Australia's Reptiles, A Photographic Reference to the Terrestrial Reptiles of Australia.* Collins Publishers Australia.

CAPTIVE BREEDING OF MULGA SNAKES *(PSEUDECHIS AUSTRALIS)* FROM CENTRAL AUSTRALIA

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Oviparity has recently been demonstrated as the reproductive mode of *Pseudechis australis* in eastern Australia (Fitzgerald and Pollitt, 1981). The species had previously been regarded as viviparous (McPhee, 1979). Due to the almost Australia wide distibution of *P.australis*, Fitzgerald and Pollitt were unsure if the reproductive mode for this species is geographically variable. This report indicates that oviparity is the form of reproduction of *P.australis* in central Australia.

In early December 1990, a 1.5 metre female *P.australis* was killed on Waite River Station 150km NNE of Alice Springs. The body appeared to contain eggs. This was thought to be strange so

the body was forwarded to the Conservation Commission of the NT for evaluation. Examination of the battered body revealed the presence of at least 9 parchment shelled eggs in the oviducts.

During December 1990 a captive female *P.australis* (1.4m) was thought to be gravid. She was housed in a large cage with another similarly sized female and a 1.6m male. No mating or courtship behaviour had been noticed. On 31 December the female laid 16 "eggs" in the sand of the cage floor. Five of these "eggs" were unshelled ova of a jelly like consistency, while the remaining 11 were normal looking parchment shelled eggs. The eggs were incubated in a medium of damp vermiculite (6:4 verm.:water) at a temperature of 30-32°C. During the first 4 weeks of incubation, 5 eggs developed extensive mould growth and were discarded. The remaining 6 eggs hatched on 6 - 8 March 1991 after 65 - 68 days of incubation. The neonates were large, 285 - 330mm SVL (mean 312mm) and averaged 13 grams in weight. This is larger than neonates in any of the clutches by Fitzgerald and Pollitt (average 224mm and 7.6g). This is surprising since average adult specimens in central Australia are relatively small, averaging about 1.4m long with very occasional specimens exceeding 1.8m.

ACKNOWLEDGEMENTS

I wish to thank Allan Coppock of Waite River, Phil Lutan of the C.C.N.T. and Denise McEwen of the Dept. Primary Industries, for the information on the specimen from Waite River Station.

REFERENCES

Fitzgerald, M. and Pollitt, C. (1981). Oviparity and Captive Breeding in the Mulga or King Brown Snake *Pseudechis australis* (Serpentes: Elapidae). *Aust. J. Herp.* 1(2):57-60

McPhee, D. (1979). *The Observers Book of Snakes and Lizards of Australia.* Jacaranda Press.

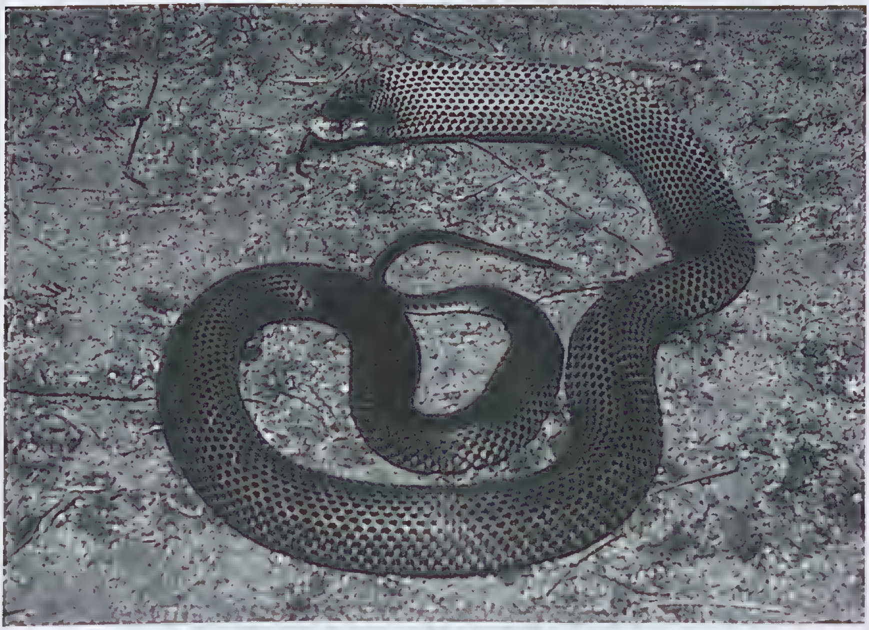

Figure 1. Mulga Snake *Pseudechis australis* from the McDonnell Ranges

AN AGGREGATION OF EASTERN BROWN SNAKES *(PSEUDONAJA TEXTILIS)*

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Aggregations in the wild have been documented for a number of species of Australian snake. A number of cases and earlier literature references are documented by Hoser (1980). Other documented cases of aggregation in Australian snakes include:

Vandermark (1989), Diamond Python *(Morelia spilota)*

Worrell (1970), Arafura File Snake *(Acrochordus arafurae)*

Fyfe and Booth (1984), Little Whip Snake *(Unechis flagellum)*

Specific cases of "pairing behaviour" in wild specimens of 12 species of Australian snake are described by Hoser (1990), who also provides a (then) up to date bibliography of documented aggregation cases in Australian snakes.

Described here is a previously unrecorded aggregation of Eastern Brown Snakes *(Pseudonaja textilis)* in southern Victoria.

During the last week of July 1991, (mid winter) Mr Reeve of Melton was working during the day at Melton Airport about 40km west of Melbourne city (GPO). The weather at the time was dry, windy and overcast. He was moving dirt to dig a trench as a water channel along the fence line. The area in question was a grassy paddock with recently cut grass and a few scattered trees. The site in question was adjacent to a water channel. A backhoe was being used at the time.

When digging up dirt beneath long dead grass a "nest" of 6 adult (between 1.2 and 2 metres) Eastern Brown Snakes *(Pseudonaja textilis)* were disturbed. All were described as being fairly torpid and as resting in a hollowed out area in a cluster. No passage to the surface was noticed.

The six snakes were all killed when discovered. Eastern Brown Snakes *(Pseudonaja textilis)* are common in the area.

REFERENCES

Fyfe, G. and Booth, P. (1984), Some notes on the habits of the Little Whip Snake, *Unechis flagellum, Herpetofauna* 6 (2), pp. 16-21.

Hoser, R.T. (1980): Further records of aggregations of various species of Australian Snake, *Herpetofauna,* 12 (1), pp. 16-22.

Hoser, R.T. (1990), Pairing behaviour in Australian Snakes, *Herptile* 15 (3), pp. 84-93.

Vandermark, J. (1989), Communal mating of Diamond Pythons, *ACT Herpetological Association Newsletter,* March, pp.10-12.

Worrell, E. (1970), *Reptiles of Australia,* Angus and Robertson, Sydney, Australia. 169 pp.

TWO RECORDS OF ROAD KILL PREDATION BY MULGA SNAKES *(PSEUDECHIS AUSTRALIS)*

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Several literature references state that the Mulga Snake *(Pseudechis australis)* feeds on "small mammals, reptiles and frogs" (Cogger 1986), "a broad range of vertebrates" (Wilson & Knowles, 1988) and "rodents, lizards and fish" (Sutherland, 1983). Shine (1987) gives details of stomach contents of 135 snakes which include 162 prey items. The percentage breakdown of these food items was:

Frogs 20.4%
Lizards 37.0% (varanids represent 6.2% of total)
Snakes 12.3%
Birds 4.9%
Mammals 25.3%

Of the 34 prey items recorded by Shine in the stomach of Northern Territory specimens, 2 were varanids (*Varanus brevicauda*, maximum snout vent length (SVL) of 20cm, and *V. acanthurus*, maximum SVL of 30cm) Although the sample size is small the maximum size of these animals suggests that only small varanids are taken by Mulga Snakes.

On Saturday the 16th of February 1991, at 10:30am I found a road killed Mulga Snake. The location was the Arnhem Highway at the Adelaide River Floodplain (12°41'S, 131°21'E). The SVL of this animal was 1500mm with a total length of 1760mm, it was male and at the time it was still moving. Dissection showed that this animal had recently eaten a Flood Plain Goanna (Varanus panoptes). The goanna had a SVL of 270mm and a total length of 650mm.

Close inspection of the varanid revealed that it had a crushed snout. This crushed and flattened snout was inconsistent with the Mulga Snake's method of taking prey. Consultation with Drs Richard Shine and Thomas Madsen suggested that for a varanid of this size to have been attacked as a prey item by this medium sized snake, the snake would have suffered some external damage, ie; claw and/or teeth marks. No marks were present on either animal which would be consistent with a subduing struggle, which leads me to believe that the Mulga Snake had actually eaten the varanid after it was already dead, possibly a road kill, with the snake being hit by a car soon after.

On Saturday 23rd of March 1991 at approximately 6:00pm, 2 kilometres south of Kununurra, W.A. (15°48'S,128°40'E) I found another road killed Mulga Snake. This animal had been dead for approximately 1 week as it had decomposed and dessicated to a large degree which allowed me to see that it had consumed a Flood Plain Goanna presumably just before being killed. It was evident that the two animals had died around the same time, as the rate of decay was similar. This snake was approximately 1500mm in length, while the varanid was about 400mm SVL. Unfortunately I was unable to determine whether the varanid was road killed or not in this instance as this snake and its prey had suffered extensive damage from being on the road for so long, and thus run over many times by vehicles.

These incidents indicate that the large Mulga snakes may eat carrion, and relatively large items at that. The Mulga Snake with its large, blunt head would appear to be an inefficient hunter when compared to other snake types, eg; Olive and Water Pythons or Eastern and Western Brown Snakes, or Whip Snakes, and this may account for its comparative rarity in the Top End. Mulga Snakes have a comparatively slow strike (pers. obs.) and as far as is known are unable

to sense prey through infra-red radiation, like pythons. Mulga Snakes tend to be nocturnal in the Top End, which would exacerbate feeding deficiencies. Because of these assumed deficiencies in predatory strategy, they may be forced to obtain food by other means. Their feeding on carrion may be a previously undiscovered feeding strategy. As the food types consumed are so varied it is fair to assume this is an opportunistic feeder. How the 162 prey items in Shine's study actually died may provide clues to the Mulga Snake's feeding strategies in Northern Australia.

REFERENCES

Cogger, H.G. (1986) *Reptiles and Amphibians of Australia.* Reed Pty. Ltd.

Shine, R. (1987) The Evolution of Viviparity: Ecological Correlates of Reproductive Mode within a Genus of Australian Snake *(Pseudechis australis) Copeia* 1987 (3).

Sutherland, S.K. (1983) *Australian Animal Toxins. The Creatures, their Toxins and Care of the Poisoned Patient.* Oxford University Press, Melbourne.

Wilson, S.K. & Knowles, D.G. (1988) *Australia's Reptiles: A Photographic Reference to the Terrestrial Reptiles of Australia.* Collins Publishers Australia.

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